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On the composition of academic work in digital times

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ABSTRACT Over the last two decades, a sense of awareness has arisen that universities are facing important challenges. This article focusses on the challenge that could be broadly termed as ‘the digitization of academic work’, yet without assuming that this digitization would be an explanatory factor clarifying the precise nature of contemporary academic work. On the contrary, and adopting a relational actor-network theory (ANT) approach, this contribution stresses the concrete composition of academic work without making any general presumptions regarding how the university is looking like nowadays. Furthermore, by introducing a specific interview technique as methodological approach and different visualizations as (qualitative) analytical approach, this article offers a threefold exploratory textual and visual analysis of academic practice in the making. First, the constitution of an academic practice is discussed, showing the prevalence of multifarious human and non-human actors, and how each of these actors is embedded in a network of interactions with other actors. Second, we show how academic practice is distributed into different regions of interacting actors. Third, the association of these different regions is analyzed with special attention for boundary actors (between different regions) and digital actors. The article concludes, firstly, that it makes not much sense anymore to talk about academic practice in terms of humans or non-humans, material or digital, etc. Instead, perhaps it makes more sense to speak of actors in academic practice as being *humandigital*. Secondly, the article concludes that sociomaterial approaches might constitute a fruitful addition to more traditional research about the university that is inclined to focus on epochal changes that are suggested or expected to alter the position of academics and the university.

Introduction

Over the last two decades, a sense of awareness has arisen that universities are both experiencing and facing important challenges. This certainly applies to the academics inhabiting these universities, and especially since the advent and proliferation of digital technologies and devices. It has been argued that many facets of the professional life of academics are increasingly rooted in digital technologies nowadays (Illich, 1991; Peters, 2006; Robins & Webster, 2002; Weller, 2011; McCluskey & Winter, 2012). Research dealing with the digitization of the academic profession is often directed towards a contextual rendering of how digital technologies and devices have a general *influence* or *impact* on academic work. Common assertions in this respect are for instance that the academic profession is being more and more networked or that it is less and less bound to a particular physical location (e.g. Kuntz, 2012; Weller, 2011). Such contextualizing approaches make an analogous move

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compared to approaches that try to explain academic functioning through other underlying grand processes and factors that are considered its prime movers (e.g. marketization, privatization, globalization – Calhoun, 2006; Herbert & Tienari, 2013; Kim, 2009; Readings, 1996): in one way or another it is argued that these evolutions are the main factors that have an impact on the academic profession.

The subjacent rationale adopted in many of these approaches is that such ‘grand’ evolutions directly alter daily academic work: being conceived as ‘input’, they are deemed to clarify how the resulting ‘output’ (academic work) is looking like today. As such, these approaches have little focus on what is happening exactly in academic practice, how academic work is precisely composed, and how digital technologies (amongst other components) give shape to academic practice. It is this *composition* of academic work that remains largely a ‘black box’ (Latour, 1987). That is to say: by considering academic work (as output) as something that is influenced or (partly) *made* by particular processes (as input), what is given little attention is how academic activity is being composed on a daily basis and how digital devices play a role in that composition. In this article, we adopt another approach that precisely tries to get grasps on how such composition looks like. This approach considers the phenomenon of ‘digitization’ not as a directly influencing input matter, but rather on the contrary as something that could be revealed (or not) after the conduct of a study with respect to the components that make up academic practice.

The structure of this article is as follows. In the first section, we give the floor to the theoretical framework that informed the actual study: Actor-Network Theory (ANT). ANT can be termed as a relational sociomaterial approach that focuses on both human and non-human agents in particular practices and that investigates empirically how these different agents assemble into (actor-)networks. Based on this theoretical framework, in a following section we introduce the methodological and analytical approach and the concrete design of the study conducted. This design consists of a detailed analysis of one academic practice that will be reported of in a following section by means of an account that is both visual and written. The use of

visualizations in the conduct of an ANT-analysis was a focal point of attention in the present study. Not only was it our purpose to investigate the composition of academic work; we also wanted to explore the possibility of conducting a sociomaterial analysis both textually and equally based on visualizations. The construction hereof is the subject of the third section. In a last conclusive section, we coin the results of this study to some more general literature regarding current evolutions concerning the university in general and (the role of the digital in) academic life in particular.

Theoretical approach: Actor-Network Theory as sensibility

In this section, we introduce the theoretical framework that informed this contribution: Actor-Network Theory (ANT). This will be done by relating ANT's key ideas directly to the central perspective of this article, that is, the composition of academic work in times of digitization. In other words, it is not our intention here to give a full-fledged account of 'the theory' of ANT, but rather three guiding principles that were central in the conduct of the present study.ⁱ These principles are often designated as *sensibilities*: rather than being a stable 'theory' as such, ANT is more of a fluid approach that focuses on phenomena in the making and that requires some specific analytical dispositions (Fenwick & Edwards, 2010; Law, 2009; Mol & Law, 1994). The three sensibilities that will be discussed here are sensibilities directed towards 1) heterogeneity, 2) relationality and 3) enactments.

Heterogeneity

In the analysis that follows, no *initial* analytical importance will be placed regarding (distinctions between) more traditional analytical concepts such as the human and the non-human, the social and the material, etc. That is to say: studies in line with the ANT-approach assume as little as possible before the actual conduct of a study. Instead of adopting these traditional concepts, ANT-studies focus on the processes by which different actors of all sorts come together and on how this 'coming together' is being established precisely.

This implies that the focus/sensibility of this study is directed to the agency of these different actors which are all treated as belonging to the same analytical plane: Which interactions are being established? Which actors (human as well as non-human) are involved in these interactions? By considering classic foundational categories (e.g. 'the academic', 'the digital', etc.) not as point of departure of the actual study and by focusing rather on the processes by which different actors of all sorts come together,

this article highlights the interconnectedness of many activities (Fenwick & Edwards, 2010; Law, 2009). This implies that the focus is on the identification of all things and people that make up academic practice and on the activities that are performed without making prior judgment regarding to what matters most or what underlies 'what'. In other words, the study reported of in this article emphasizes the heterogeneity of academic practice: consisting of a varied range of different actors whose differences in possible impact or role do not matter at the outset, for each actor was analyzed in the same way.ⁱⁱ Latour (e.g. 2005) hinted a couple of times at replacing the more human-centered concept of 'actor' with that of the more agency-reminiscent term 'actant' so as to avoid suggesting a conceptual human-centeredness. The term 'actor', however, seems to prevail in the literature. In what follows, both terms will be used interchangeably and as synonyms.

Relationality

Based on this first sensibility, it could be assumed that the project of ANT-studies is to unfold the heterogeneity of actors and how these different actors coexist in everyday life. Such assumption would, however, refrain from taking into account two more sensibilities that are equally decisive in pursuing an adequate ANT-account. 'Relationality' is the second sensibility that guided this study. That is to say: we took as second point of departure the view that agency is neither a characteristic of one particular (human) actor nor explained by looking at one singular actor or factor, but rather distributed and located within the webs of relations within which each actor is located, viz.: that all things are what they are in relation to other things (Law, 2009; Gad & Jensen, 2010). To take a simple example such as a printer: it is only in the relation of a printer with other actors (paper, secretary, computer network, files...) that this printer can actually work, and hence, it is not sufficient to look solely at this printer in order to understand its agency. ANT studies often speak about such webs of relations between heterogeneous actors in terms of *networks*, or what is sometimes equally called an *assemblage*ⁱⁱⁱ. In other words, upholding this relational

sensibility implies seeing both actors and networks as being constantly transformed by relations vis-à-vis other actors and networks (see Callon, 1986; Latour, 2005). The central aim of this study, then, is to find ways to understand and describe academic work not by analyzing the agency of the academic (alone), but on the contrary by focusing relationally on how different human and non-human actors are enacted within webs of interactions and on how and what kind of agency is distributed within these webs (Callon & Muniesa, 2005). In this study we analyze the distribution of agency by looking, first, at the level of actors and *interactions*, that is, at all sorts of human actors and things, and at the way they interact. This mapping allows to focus on different *operations* in academic practice, that is, on a description of what happens (e.g. composing text, doing calculations...) in a clustering of actors and their interactions (e.g. a clustering with respect to grading students). In line with the topological language of webs and networks, we will use the notion of *region* to distinguish and describe several clusterings that unfold when academic practice is described in terms of actors and networks. The notion of *operational effect* is used to describe the effect of operations that make up or compose a region. With the notion 'effect', we want to stress that we do not want to understand or explain academic practice by focusing on its functions or goals, but rather by looking at emerging mechanisms. In sum, what academics are doing on a daily basis will be described in terms of several regions of operations they (and several other actors) are engaged in, and on the effects of these academic operations.

Enactments

This study, being centrally concerned with tracing which actors act in a particular situation and with how (if) these actors relate towards each other, is centrally interested in what could be called 'the emergent'. The focus of the account that follows lays upon academic *practice*. When using the term 'practice', we designate something that is emerging/in the making, rather than being 'made': the term practice refers to things that happen and that are made to be happening by several people and by lots of things. The term 'practice', by pointing to that what is in the making, thus designates the multiplicity and the complexity of relations and related operations and how they appear in their emergence (Mol, 2002). By conceiving academic reality as becoming/emerging, this study shares with other ANT-studies the conviction that each practice is assembled (Latour, 2005; Law, 2009), and hence that each assemblage is a momentary state of what we termed operations and regions. Academic operations and regions hence are always in the making. The implication

hereof is not that each region, with its operations, would be necessarily disconnected from other regions and their operations. On the contrary, ANT-studies, sometimes designated as doing ‘sociologies of associations’ (e.g. Latour, 2005), are equally concerned with how different regions might share some mutual actants. The example of the printer is again instructive, for it could be expected that this device is part of, or rather enacted within, several operations such as for instance grading students or reviewing literature. The study of these *associations* of regions is then often looking at those actors in an assemblage that overlap with other assemblages, and that hence, in a certain sense, reside on the border of two (or more) regions in an academic practice. In line with this perspective, it is important to stress again that we describe an academic practice not from the viewpoint of the academic, but instead consider the academic - in what he or she is doing and relating to - to be part of a practice of operations and regions in which he or she, together with other actors, is engaged (Mol, 2002; Moser, 2008).

In summary, relying on these three sensibilities, we attempt to describe the composition of academic practice in the making on a relational plane, and thus by taking into account the agency of both human and non-human actors, in three steps. First, the *constitution* of the actor-network will be discussed: how do actors in academic practice establish interactions, and how are they themselves established by their interactions? After having described this constitution,, in a second step we will answer the question of distributed agency in the constituted practice: how is academic work *distributed* in larger wholes, that is, what are the regions and their operations that make up academic practice? The focus is on sets of distinctive operations and their effects; operations and effects that can be identified when looking at academic practices in terms of an actor-network. In a third step, the *associations* between the described regions will be discussed. That is to say: in this third section, we will analyze whether or not different regionalizations are related towards each other and, if so, how precisely. Before engaging with these guiding

questions, we will first highlight our methodological and analytical approach that consisted of conducting and analyzing interviews in a distinctive way, and that had specific implications for how our described accounts were constructed (both textually and visually).

Methodological and analytical approach

Upholding the sensibilities above has consequences with respect to how to conduct research and with which methods and analytical tools to conduct this research (Latour et al., 2012; Landri, 2012). A first consequence relates to the *mode of description* and more particularly to how precisely to describe academic practice relationally. A second consequence pertains to how to *collect data* and more particularly to the conduct of investigating academic practice. A third consequence relates to the *mode of analysis*, and more particularly to how precisely to analyze the data collected. As will be made clear, this study experimentally tries to explore the potential of introducing visualizations of sociomaterial assemblages in the conduct of actor-network studies. Using visualizations not as mere illustrations but as integral part of the present study, is an analytical technique of which the importance has been recognized recently, but that has been used only very scarcely up to now (and certainly in the field of educational research) (Latour et al., 2012; Marres, 2012).

As far as concrete investigation is concerned, Latour (2005; see also Venturini, 2010; 2012) has summarized the methodological project of ANT as a call for closely ‘following the actors’ in daily concrete situations and for sticking to ‘mere description’ instead of searching for overarching explanations. This focus on and closeness to practices is reminiscent of traditional ethnographic research in the sense that both share an emphasis upon everyday actions, activities and behaviors of (both human and non-human) actors. Both the actor-network and the ethnographic tradition consider practices to be thick and are conceived as heterogeneous assemblages composed of and encompassing many-layered actors, relations and associations between these actors (Nimmo, 2011; Prabhala, Loi & Ganapathy, 2011; Sørensen, 2009; Westbrook, 2008). This notion of thick description should not be adopted only in the sense of being highly attentive to details. It also pertains to the *style* of the descriptions, for “Thickness should also designate: ‘Have I assembled enough?’” (Latour, 2005: f.192). In line with these thoughts, one can rely on the classic notion of thick description as far as one understands ‘thick’ in a specific way: as referring to the following, or tracing, of every one and every thing in their course of action. These



sorts of descriptions are then less 'in depth' (and including contextual information) but more flat, taking concrete actors and actions (in their relationality) as point of departure (Geertz, 1973; Pole & Morrison, 2003). These notions of thick and flat description do not preclude the fact that what is described needs to be conceptualized, or to say this otherwise: that an adequate account of what happens in a specific situation needs to be given. In order to compose such adequate accounts, ANT-studies have provided a whole series of what could be called quasi-concepts: *concepts* because they try to offer an account of what happens in a particular situation, *quasi-concepts* because these concepts do not jump towards the level of providing explanatory generalizations and do not radically impose some kind of metalanguage on the language used within the described practices themselves. Examples are: obligatory passage point (Callon, 1986); center of calculation (Latour, 2005); etc. These already existing quasi-concepts might be useful in constructing one's own description, yet very often new quasi-concepts that fit better to the situation at hand need to be introduced in order to arrive at such an 'adequate account' (Latour, 2005). In what follows, we will engage in this kind of quasi-conceptual work when it comes to giving an account of the operations, the regions and the effects that are part of the composition of academic practice.

In order to be able to describe academic practice, we first of all had to find a way to follow the actors populating this practice (Czarniawska, 2007). It was our supposition that this would require a particular research design. Traditional direct observation of academics in interaction with other actors, such as for instance digital devices, would prove to be difficult. We were particularly doubtful whether direct access to computer activities (e.g. who is skyped or e-mailed with, which websites are visited, etc.) would be granted – especially considering that, in many cases, these devices are being used for both personal and professional purposes. In order to avoid this privacy issue, another way was sought so as to gain a detailed look at and to trace the activities that were performed in academic practice. We interviewed six professors (different countries, universities and fields of research) about the course of their

previous working day, focusing not so much on the *contents* or *meanings* of activities that were performed that day but rather on the *actors* and the *relations* that were involved in these activities. Due to the experimental nature of the analysis that follows, in this article we limit us to the presentation of one interview and focus on the exploration of adequate textual and visual accounts. The interview that will be reported of was conducted with Mary, a professor in the field of bio-engineering. In order to focus on the level of actual interactions, the interview was reminiscent of a *hearing* where she was asked to report on every detail of what she did the previous day. This was being done in a highly accurate manner, from the moment of waking up until the moment of going to sleep. For instance, if the respondent said she was writing a paper, the focus laid upon with which device, with which software, with the assistance of which books, and so on, rather than on the particular content of the paper or on the (feelings, meaning-giving of the) person writing this paper. This led to a lengthy conversation (1,5h) in which many small and short questions (rather than grand questions about particular topics or phenomena) were asked, such as for instance in the following interview excerpt, which reports of a rehearsal of a student's thesis defence:

- The presentation was still very minimal. So actually, we first remade the presentation together.

- **For the defense?**

- For the defense. And actually, they [the students] did not do a defense yesterday, because the official defense was planned for today.

- **Today was the defense, okay.**

- Yesterday was... hmm... Because I am a promoter of these students, I always give them the chance to rehearse once. To see them in advance. But in fact, we have been tinkering more with the presentation than that they have been rehearsing their defense.

- **And in the meantime, hmm, I am trying to imagine all of this; was this projected?**

- The meeting took place in the meeting room downstairs, and there is a beamer over there so that one can always project on a wall. The only thing to bring yourself is a pc. So, I brought my pc and we were just sitting at the table and we could look.

- **Whilst the student was presenting?**

- Actually, during the period that we discussed the slides. And eventually, we have adapted the slides together. Uh... I have given them slides from other presentations that I had modified, so that they could withdraw things from these slides for [their defense] today. And this meeting took place until... Well, I had another meeting at half past three. But I was eleven minutes late. *(laughs)*

- **Eleven minutes?! *(laughs)***

- Yes, they pointed to my eleven-minute delay, that's how I know. Hmm, that meeting took place in my office, but not immediately, because... Yes... in the meantime, one of the persons was engaged in a conversation with another person and... thus... I think the meeting took place at about quarter past three.

- **And in the meantime?**

- In the meantime, I did some research about a conference I attended two weeks ago. I heard something there that seemed interesting for one of the research projects, so I had to look up a patent and some articles that were pointed to there. I have been searching, printing, and looking at these articles.

As this excerpt illustrates, the conduct of interviews as a kind of hearing was used as a (more indirect) alternative for participant observation in cases where such observation is not appropriate or feasible. Slightly inspired by the more well-known

interview to the double, where respondents are asked what a double of them would have to do in order to function normally during the course of a working day (Nicolini, 2009), the interviews were then treated as observer notes that try to articulate and re-present academic practice by departing from all actors and interactions performed the previous day. In that sense, we did not add interpretations to the interviewees' responses but rather adhered to their *infralanguage* by means of not adding any explanatory or contextual elements to the things each academic said (Latour, 2005, but see also the elaboration of the notion of quasi-concepts above). In summary, the interview transcripts served a double finality. First, the interview aimed at obtaining access to the level of actors and interactions, and that served as an input for the data analysis and visualization in the next research step. Second, the interview also allowed to obtain access to the context and infralanguage of academics, and this knowledge was also used as a companion that assisted in the description of academic practice of which we will report in what follows.

Constructing visual accounts

Recalling from the theoretical framework that every-thing and every-one might possibly be an actor, as long as this actor leaves a trace and hence inter-acts with another actor, a first step in the construction of textual and visual accounts consisted of a study of the transcript for *actors* that were mentioned. Precision and high level of detail were of primary importance in this respect. Actors were withdrawn from the interview on a scale as small as possible and as distinct as possible. For instance, if the interviewee mentioned that she used a software program on her computer, 'computer' was not used as the description of an actor. Instead, the program (e.g. MS Word), or, when mentioned by the interviewee, the (sub-)function of the program (e.g. the mailing function of MS Outlook), was enlisted as being an actor. Especially when computer activity was concerned, the challenge was to unfold this assemblage in such a way that 'black boxing' was avoided (Latour, 1987). As far as the *interactions* were concerned: an interaction was registered each time some kind of action

occurred between two (or more) actors.^{iv} This process of data coding resulted in 84 actors and 200 interactions.

In a following step, the thus obtained actors and interactions were manually entered in a network visualization program called Gephi (www.gephi.org; Bastian, Heymann, & Jacomy, 2009). Gephi allows the visualization of actors (*nodes*) and the interactions between these actors (*edges*) in a flexible network structure where the user of the interface can design a network according to her own criteria and according to a variety of different kinds of lay-outs and parameters. Compared to other similar software, Gephi is conceived by its makers to be a tool focusing primarily on visualization, rather than being (only) a mathematical framework on which all parameters and lay-out options should be modeled (Jacomy, 2011). Gephi is hence a software tool that can be deployed for adopting a relational gaze and for investigating which actors actually interact and which do not interact (directly), without having to assume that the program imposes any other underlying structure or reality to the findings than bundles of actors based on interactions (Knox, Savage & Harvey, 2006). Gephi however includes features which are directed at the visual description of the graph and that can be adapted by the user of the program. The actor-networks that will be presented in the following section were visualized according to following features:

- * The overall shape of the network was set using Gephi's ForceAtlas algorithm (Jacomy, 2011). The idea behind this algorithm is that connected nodes attract each other, whereas non-connected nodes are pushed apart. This implies that actors visualized close to each other are (relatively) directly connected, whereas actors that are positioned distant from each other are (relatively) indirectly connected – this last point meaning that there is no direct connection between two actors, but only a 'path' of different actors and interactions to be followed in order to obtain some sort of connection between two actors. As stated above, in what follows, attention will be given to clusterings of actors and activities, rather than to paths of otherwise not directly connected actors. These force-based clusterings are then not based on the *intentions* of actors or on the *kind* and *contents* of these interactions, but rather on the intensity of interactions with other actors. By performing specific (force-based) operations on the actors and interactions entered, Gephi visualizes *regions* of actors and interactions that tend to interact intensively with each other and hence allows to focus on the agency within these regions. In other words, instead of looking at academic practice from a priori domains of actions, Gephi visualizations allow to construct regions of actors based on the intensity of their interactions.

- * The thickness of each separate node is related to its degree of connectedness: the more an actor interacts with other actors, the bigger its size.

- * Once all entered into the database, it is possible to show or hide particular selected actors and interactions in the overall network. In the following, at times we have chosen to include or exclude particular actors as a deliberate strategy that is part of the network description (see Figure 3).

* A vector graphics editor (Inkscape) was used in order to stress a particular region of the network by encircling/highlighting it (see Figures 2-3).

In the next sections, the resulting textual and visual accounts will be presented. As already stated earlier, this will be effectuated by complementing visual with written descriptions in three steps: the *constitution* of academic practice in terms of actors and interactions, its *distribution* in terms of regions, operations and operational effects and finally the *association* in terms of relationships between regions in academic practice.

Textual and visual accounts of academic practice

Constitution: Coexisting actors

The first visualization consists of a graph rendered by Gephi and displaying all actors and interactions. In this figure, we can see different actors of different sorts: Mary herself, pieces of software, colleagues and other co-workers, patents, paper, transportation vehicles, texts, different log-ins, communication devices of different kinds, and so forth.



who are living and working in the United States. Spreading out rapidly, we can start to see how the interactions of a particular actor define what that actor is, does, and can do. Or stated otherwise: we can start to see that in order to describe any (arbitrary) actor, it is necessary to describe the network of interactions with other actors within which this actor is situated. The patent would not have had the same agential capacity (and would have perhaps acted as a different entity) without an overarching database, an applicant to search in the database, a search engine to search for the applicant that searches in the database, a login granting access to (that particular piece of) the internet, a web browser to navigate to the search engine, and all the interactions between these actors.

Descriptions and visualizations as the one above, focusing on the constitution of the network, provide one possible way to describe networks relationally: starting with a particular actor (e.g. 'patent'), it is possible to read the constitution of the network by means of analyzing the interactions that this actor establishes with other actors. This focus on the coexistence of different actors and their interactions, however, closely resembles more traditional forms of social network analysis in which 'networks' are considered to be a blueprint and/or representing the a priori structure of social life (Knox et al., 2006). In our study, this is however only the first step, and moreover, the visualizations are not used to represent a kind of underlying network structure but rather as an attempt to give an adequate – both textual and visual – account of how academic practice is composed and how academic agency is possible when looking at clusterings of actors and interactions. As a consequence, it is necessary to pay direct attention, in a second step, to how

academic agency is *distributed in* (and mediated by) larger wholes, and in a third step to how these larger wholes *associate with* each other. Specific attention will thus be devoted to descriptions that pay attention to the distributive and associative characteristics of the actor-network.

Distribution: Regions

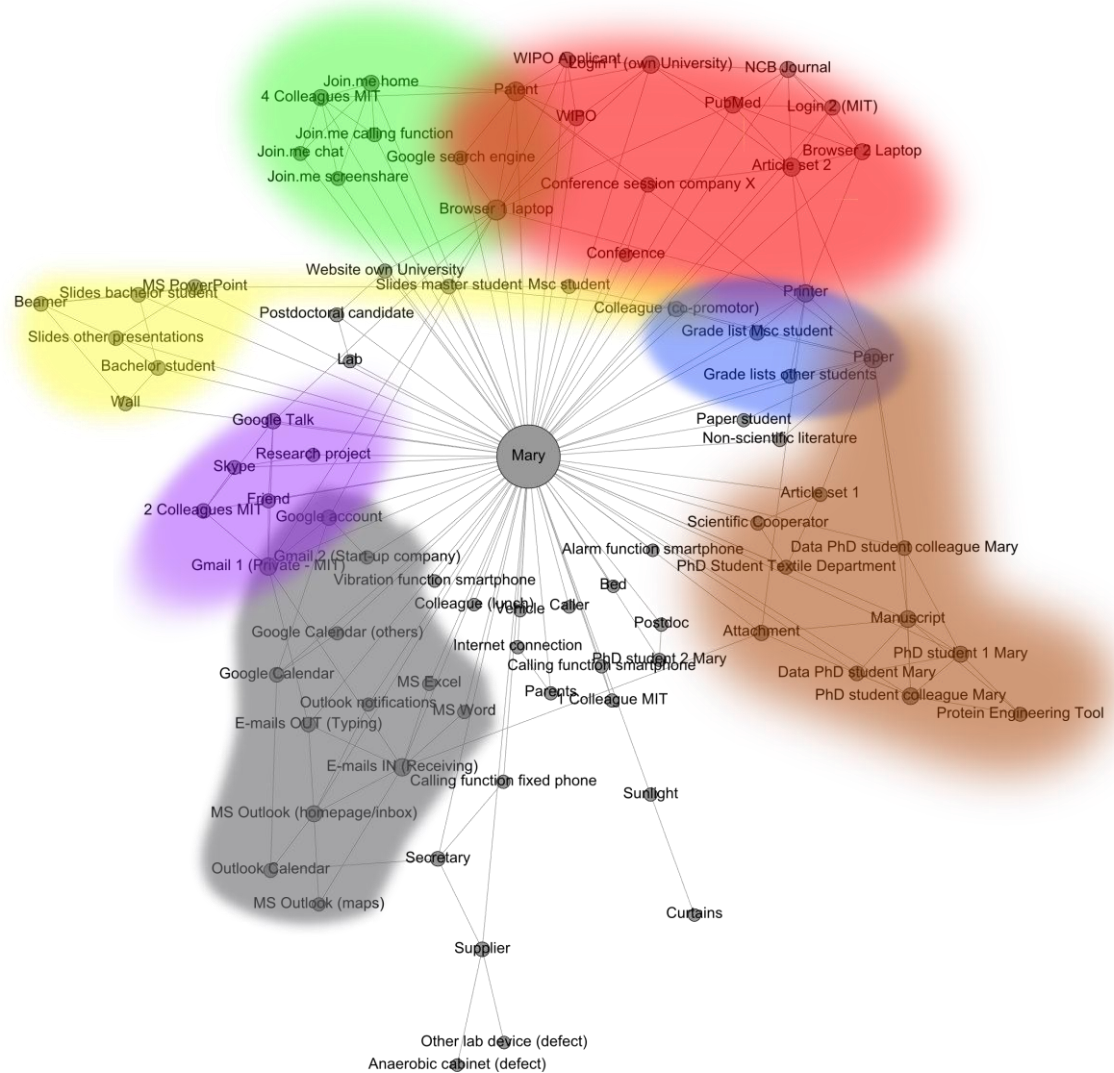


Figure 2. Actor-network of Mary's course of the day with particular regions highlighted. Since Mary is implied in almost each interaction, for the sake of visual clarity she was not included in the different highlighted regions.

Figure 2 is the same visualization as Figure 1, but with some specific regionalisations highlighted. These regions were constructed by highlighting clusters of actors that interact with each other, that is, these are the clusters of actors and interactions that emerge and become visible when looking at academic practice topologically (see earlier in this article: force-based method forming regionalizations). Seven different



regions are foregrounded. In the descriptions that follow, we will point at different operations that are taking place in each region and by means of which different operational effects are performed. Take, for instance, the yellow region at the left. This group contains actors related to **preparing** a defense (see the interview transcript given above): we can see presentation software (MS PowerPoint), different slides of different students that were projected and integrated into the presentation of the defending student, a beamer, and two persons (a bachelor student and a colleague of Mary). The interactions depicted in this region consist of this bachelor student (in front of her promoters) rehearsing the defense that she had to present officially the next day and, afterwards, a revision of this PowerPoint presentation conducted by both the student and these two promoters (Mary and a colleague of hers). Different operations assisted in enacting this region into being: by rehearsing the defense, a future event was *projected* as happening in the present of that day. Furthermore, slides of different presentations were considered as being different *modules* that can be inserted in one overarching presentation. This implies that these different presentations were treated as being *analogue* with respect to their ability to contribute to the defense of a single student. Secondly, the brown region shows a clustering around manuscripts written by different PhD-students. What this region highlights, is the **processing of a text**: by discussing manuscripts, texts are processed in such a way that language takes up a further digital form. Again, the region displays no isolated actor and interactions but on the contrary involves many different actors and interactions in order to process text. A lot of actants and interactions need to be mobilized: the PhD-students themselves, scientific cooperators, data produced by different persons, software tools, other articles. Equally, a lot of operations are at work in order for this region to operate: language was *textualized*, points of view vis-à-vis a particular text *multiplied*, previous versions of these manuscripts were *redacted*. Third, and as far as the blue region of the visualization is concerned, in this section we can see the same colleague of Mary together with some grade lists that were printed on paper. In this case, the region that is formed is equally composed of a

form of **processing**, but this time of **students**: the blue region depicts a meeting in which Mary and her colleague deliberated whether or not different students were eligible to obtain a particular grade. This was rendered possible by the *delegation* of activities students performed during a whole academic year (and other human and non-human actants that co-constituted this activity) in a tiny list of grades. Indeed, by means of a couple of people and paper documents (grade lists), a judgment is formed that *grades* and thus processes all work students performed in the course of a year into a single *number*.

It is particularly interesting to see how these three regions, as clusterings of different actors and their mutual interactions, and the operations that take place in each of these regions, bring about different operational effects. That is to say: each region entails particular mechanisms that modify what each actor is, does, and can do. It would be impossible to describe all operational effects. Therefore, we will limit ourselves to the effect generated by the central operations in each region. In the preparing practice, for instance, the future (the defense) is being designed, but this designing at once implies that *present activities themselves* (in the form of rehearsing and the modification of powerpoint slides) are being organized in order for the future to happen in this particular manner. In the case of text processing, different authors that contributed to the manuscript are coming into being, and this creation of authorship directly implies that these manuscripts are being mandated, that is, that a manuscript is being made to circulate and to speak *for itself*. In the region of student processing, students receive added value and by this very act of evaluation, Mary and her colleague are themselves at once rendered as being centers of authority (that are able to judge) and validity (that are making a right judgment) for students. In other words, academic practice is composed of regions, each with particular operations that perform certain effects. It is important to stress that these effects are not to be understood as one-way causations or input-output relations, but instead as mechanisms that modify several actors at the same time in the their process of execution: being engaged in designing a future *is at the same time* moderating present activities, the creation of authorship *is at the same time* mandating manuscripts, and students receiving added value *is at the same time* the establishment of centers of authority/validity (see table 1).

A similar description can be made for the other clusterings of actors and interactions. The green one, for example, displays Mary and four colleagues working overseas at MIT, in what could be referred to as **convening**. The meeting that is displayed in this region took place by means of a piece of software called Join.me, which is a meeting



tool by which one can not only video call each other, but also share each other's screen footage. The already discussed patent makes a new appearance here: retrieved by a search engine and a browser, it is shared amongst the participants of the meeting and the meeting tool. What is happening in that meeting? Things are being said to each other, thoughts are being typed into the chat window, opinions are uttered, strategies re-viewed. In other words, both humans (Mary, colleagues) and non-humans (a software program with a manifold of functions, a patent, a browser) are *allocated* over different parts of different screens, thus forming an assemblage in which both these humans and non-humans are *figured* and *textualized* into a particular imbroglio. It is an imbroglio where language, interactions, emotions, concepts, strategies, inventions, and so on are dealt with in a *fluid virtual gathering*, but this gathering gives at once a *stable reality* to the invention (in the form of a patent) discussed; the virtual gathering around the invention constitutes a reality.

What about the red region in the upper right? This region displays activities that took place with respect to **retrieving** the aforementioned patent on the internet. Some familiar actants can be found here: the patent database and its applicant, a (first) login and a conference session. Since the daily browser was only able to log in at one account at a time, a second browser was used for navigating to journals not accessible by the login of Mary's prime affiliation. Mary's second affiliation to another university, however, enabled a second browser and a second login to obtain articles from the journal 'NCB' (Nature Chemical Biology) – articles that were searched first of all by the search engine PubMed and that were printed afterwards. This practice, then, is enacted by operations of *localization* (of the patent on the world wide web) and *privatization*: the information that is retrieved is not available for every interested reader to localize, but requires a bypass in the form of a login in order to be granted access. Another operation at work is an operation of *exscription*, by which something is given 'out of hand' and in that sense being exscribed to another location. In order to retrieve a patent, for instance, the search terms are exscribed from the first

localization and the concomitant first login request to *another* website (the journal website, denying entrance), from the second browser and the second login to *another* website containing *another* database, from this database to *another* applicant, and so on. In other words, public research results are requested, but this requesting at once entails a disclosing of either availability (in case of a correct browser-login combination) or unavailability (in case of an dysfunctional combination).

Another region pertaining to the distribution of the network is the bottom grey one. This region displays a **communicating** clustering – communication here referring to more than passing information, but referring to what is needed. More specifically, all actors that were permanently mobilized – in the sense that they were permanently at hand in a standby position – in the course of the day are displayed here: different e-mail accounts that were active all day long and that were maintained either by a browser or by an e-mail program, calendars of different people that furthermore synchronized through a Google account, notifications that popped up on the laptop or smartphone screen when a new message arrived. These actors, which are not only permanently mobilizing humans (for instance, mails being checked by Mary) but also each other by means of synchronization (e.g. Mary's calendar automatically synchronizes with calendars of other people when these people add or change a particular time slot), are in a certain sense realizing academic presence: Mary, but equally other people with a Google account or with a connected calendar, is being rendered present by displaying her calendar and a permanently mobilized e-mail account, for instance. This realizing of academic presence is at the same time creating and sustaining (potential) future interactions with others: knowing when someone is available (or not), or being available for incoming messages and notifications (or not), activates the possibility of interaction with this or that person.

The last region on the map, the purple one, is directed towards **arranging** particular things. Here, we retrieve again the e-mail and Google account, but equally another VoIP program (Skype) and a chat program, some colleagues, a friend and a research project. What is visualized in this region is a conversation Mary had with these colleagues both on Skype and on a chat program, and a conversation she had with a friend on that same chat program. Again, we see how spoken language is textualized and how human actors are figured onto a screen, but equally how an operation of consultation of different software programs enacts processes of arranging. This arranging brings about operational effects where making commitments to other colleagues and friends is at the same time deploying several social prostheses: not

only a VoIP program, but equally an account, another chat program and an e-mail program.

Table 1. Overview of different regions, operations and operational effects.

	Operations	Regions	Operational effects
Yellow	Analogization	Preparing	Designing a future
	Modularization		≈
	Projection		Organizing present activities
Brown	Textualization	Text processing	Creating authorship
	Multiplication		≈
	Redaction		Mandating manuscripts
Blue	Numerification	Student processing	Adding value to students
	Delegation		≈
	Gradation		Establishing a center of authority/validity
Green	Allocation	Convening	Conducting a fluid virtual gathering
	Figuration		≈
	Textualisation		Giving a stable reality to something
Red	Exscription	Retrieving	Requesting public research results
	Localization		≈
	Privatization		Disclosing (un)availability

Grey	Mobilization Synchronization	Communicating	Realizing academic presence ≈ Creating and sustaining (potential) interactions
Purple	Textualization Figuration Consultation	Arranging	Making commitments ≈ Deploying social prostheses

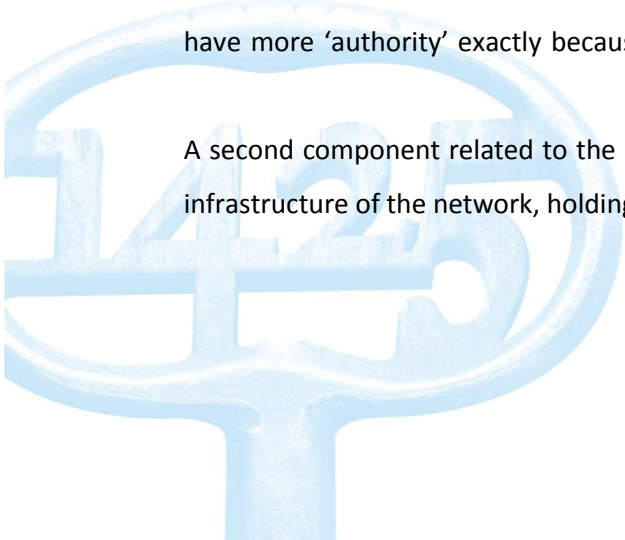
In sum, textual and visual accounts in terms of clusters of actors and interactions show that, and how, academic practice is composed of several region. We have described how each of these clusterings entails some very specific operations that allow for each actor (Mary, but equally all other actors) to do what one did on that particular day. Furthermore, instead of explaining academic practice by its aims, functions or intentions, each regionalization allows to describe specific operational effects: academic practice in the making means for example for Mary that through her activities, she is engaged in establishing authority, sustaining potential interactions, designing the future,... The next paragraph analyzes how these different regions associate with each other, viz.: how does one clustering of actors and interactions relate to another one? Are there even clusters to be found that are related at all? Are there some actors in academic practice that glue different regions together?

Association: Boundary actors, infrastructure

Figure 2 additionally demonstrates that several actors are situated at the intersection of two or more different regions: a printer, paper, the patent, a browser, a search engine, a mail function, a Google account and a colleague of Mary. That these actors are situated at such intersections, or, in other words, that they are residing at the border of two different regions, implies that these boundary actors^v make it possible for multiple regions to be enacted in that particular matter. Without paper and a printer for instance, Mary would never have been able to judge a student's work with a colleague (with printed grade lists lying in between them) or discuss manuscripts with PhD students in this particular way. Equally, without these two boundary actors, the patent or the article set would remain somewhere in the browser, inhibiting the possibility to show only the online meeting on the laptop screen (instead, Mary would have had to switch between different windows: that of the browser, and that of the join.me software). Or to state this in other words, each of these boundary actors is

employed in both these practices and thus enables for switching between two adjacent regions. For instance, both the printer and the paper possess the capability of mediating different aspects of academic work and switching rather easily between them (having a meeting, discussing manuscripts, judging). The same applies for the other boundary actors: the browser enabling the permanent mobilization of various other actors (e.g. different e-mail accounts and calendars) and the retrieval of particular information such as a patent; the patent itself being at once both a subject of discussion or an object of retrieval; Mary's colleague enabling the effectuation of a trial presentation and acts of mutual judgment; etc. Boundary actors, by means of their capability to switch between and to mediate different interactions, are a first component of the association of academic practice, that is, they are important elements in the composition of different regions. A patent can be articulated both as subject of discussion or as object of retrieval; a browser can be articulated as being an enabler of mobilizations or as a retriever of information, etc. It is important to stress here that, precisely because these boundary actors are employed differently, they function as rather undetermined agents: the different usages in different regions places them (in contrast to more embedded actors) on their own. Boundary actors such as a Google account, a patent, a printer, are consequentially somehow highly visual and perhaps appear almost as mere 'objects' to be used, but not because they are disconnected and stand on their own. Rather, they are boundary and, as such, have more 'authority' exactly because they interact with actors of different regions.

A second component related to the association of academic practice, pertains to the infrastructure of the network, holding different actors and clusterings into place.



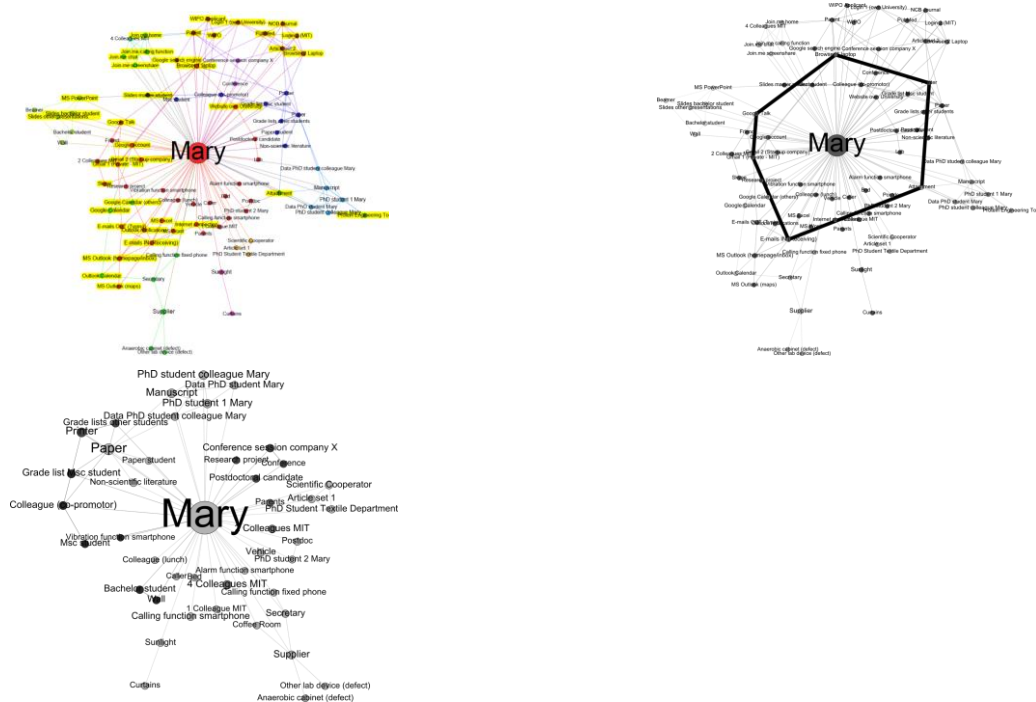


Figure 3. Actor-network with all digital actors highlighted (left), particular digital actors forming the network's abutment highlighted (middle), and all digital actors omitted (right).

In Figure 3a, every digital actor is highlighted on the left side: pieces of software (e.g. Join.me, the Protein Engineering Tool), computer programs (e.g. Word, Excel), apps (e.g. calendar), communications (e.g. incoming and outgoing e-mails), websites (e.g. search engines, WIPO), etc. It takes little effort to see that these actors are quintessential in relation to the rest of the map: when we remove these actors, the network breaks apart in a bunch of 'isles' (a tiny and isolated bunch of connected actors) and 'satellites' (one isolated actor connecting solely to Mary) as can be seen in Figure 3c on the right where actors of (obvious) digital nature were omitted. Most remaining actors only have one connection left (with Mary) or assemble into a tiny and isolated isle centered around the actor paper. Without e-mail programs, web browsers, internet connection, communication programs and office software, the academic assemblage on that particular day would indeed stop to be an associated assemblage but rather a disparate whole. How to account for this? Digital actors are spread all over the map. In that sense, these actors form a cloud or a swarm that is spread all over the network and are in that sense *inciting* the network. This means that they allowed for the performing of all the activities and operations that day rather than being for instance one singular point (and region) in the network that one should pass. In contradistinction with the notion of 'boundary actors', this digital swarm is not related to two particular regions of the network but rather connecting throughout. It could thus be stated that this swarm constitutes the 'infrastructure' of the (networked) academic practice, consisting of both more connected actors that are



omnipresent (e.g. browser) and more marginal actors whose presence is not large but equally pervasive with regards to the academic practice that is eventually formed (e.g. calendar). The different regions in the academic practice in other words share a similar infrastructure. In a similar vein, if one looks at Figure 3b, we can see a highlighted polygon tying together six digital actors. Drawing again on topological language, it could be stated that this hexagon acts as a digital interface allowing for fast transportation between different regions of the network: this polygon of computer-related actors ties together most other regions on the map in such a way that it is rendered possible to switch fairly rapidly between different regions. Since the polygon is consisting of computer-related actors, Mary did not need to move or dislocate herself in order to switch between different regions. In this academic practice, there are thus not only boundary objects discernible, but equally a digital 'interface' connecting several regions and hence enabling a relatively fast switching from one practice to the other without having to move oneself. The digital actors of the assemblage, clearly, make certain things possible such as communicating overseas by means of the join.me program, finding a patent in a database, or e-mailing for instance. More important, however, is that these actors make it possible to switch between, for instance, student processing and text processing and, due to the infrastructure that acts as an interface, to switch quickly from one academic region to the other without actually moving.

Discussion and conclusion

In this contribution, we tried to trace the composition of academic work with a particular focus on the role of both human and non-human elements herein (Latour, 2005; Landri & Neumann, this issue). Indeed, approaching the composition of academic work as consisting of actors and interactions that are always (in the process of being) in the making, allows to see the vast amount of such actors and interactions that are mobilized in order for academic practice to be taking place at all (constitutions), to see the clustering in academic regions (distribution) and to look at

how regions of academic practice relate and assemble (association). In this conclusive section, the findings of this study will be highlighted and we will try to show what can be gained by investigating the composition of academic work from a sociomaterial approach.

As was stated in the introduction of this article, many research dealing with the current condition of the university today is focusing on major societal evolutions, such as digitization, and how these evolutions impact or influence what it is to be an academic or a university today. These ways of conceptualizing tend to presuppose that there already *is* something called “a university” as being a contrivance of some sort and delineated academic work performed in this institution (cf. Calhoun, 2006; Oakeshott, 2004). This study, on the other hand, analyzed academic work from the viewpoint of the daily activities performed by an academic and without specific presumptions about the nature or purpose of these activities. That is to say: we did not consider digitization as being an input factor that directly influenced academic work (as output) but rather investigated the concrete interactions and operations involved in the composition of academic work. Hence, our starting point was that academic activities are *enacted* in practice rather than already predetermined beforehand (Latour, 1987; Mol, 2002; Law, 2009). This was in a first movement made manifest by analyzing the constitution of the network, by which we tried to demonstrate a first consequence of adopting a relational point of view, that is, that different actors can do what they do because of their interactions.

The analysis of the distribution of academic work in terms of its regions pushed this relational point of view further, by demonstrating that there are equally clusters of actors and interactions into larger wholes that take up the form of a designated *region*; the actors in these clusters interact more among themselves than with other actors. This, first of all, made clear that a very variegated amount of different regions are being established in the course of one day. If Mary would only have read a scientific book during that particular day, for instance, the network would only have consisted of a very tiny amount of actors and interactions (and hence, there would be only one region which would coincide with the overall network itself). Secondly, the analysis of the distribution tried to conceptualize what happens in these regions of academic practice, and moreover how each of these regions has operational effects, that is, mechanisms that are put into action when operations are performed. The region of convening, for instance, transforms an invention/patent into a stable reality but at once also render this reality very fluid; text processing creates authorship which is at the same time a process where scientific manuscripts received a kind of



mandate; mobilizing and synchronizing operations in a communicating practices realize academic presence, which is at the same time creating and sustaining a condition of potential interactions, etc.

In a third step, this study showed that different boundary actors associate different regions and in this way stabilize academic work; they enable to switch quickly and efficiently from one region to another adjacent one, and hence from activities related to convening to retrieving, from communicating to planning, etc. As such, boundary actors do not possess one unequivocal function but, on the contrary, install a certain efficiency and flexibility that allows to conduct a manifold of different activities in the course of one single day. Moreover, their interconnectedness gives them also a certain authority, at least in comparison to other actors that are completely embedded within one region. It is in this respect that it might be hypothesized that such boundary actors - a browser, a printer, a colleague, Google - precisely because they enact different academic activities simultaneously, are prototypical 'academic actors'. At least, they seem to express things that several different regions in academic practice share. This process of association was furthermore highlighted by pointing to the infrastructure of the network: digital actors were immanently present in academic work. This on itself is of course nothing new. However, by showing that the infrastructure of the network is of a digital nature and in a sense even forming the interface of the network, it seems not to make much sense anymore to talk about academic practice in terms of humans or non-humans, material or digital, etc., It perhaps makes more sense to speak of each actor in the network as being *humandigital*. Considered likewise, it seems no longer fruitful to speak about 'the digitization of the academic profession' as if digitization constitutes some kind of input factor that directly alters academic work (as output). Rather, further research along these lines could focus on questions such as: how are humandigital interfaces looking like precisely?, how does the fact that an academic herself does not need to move in order to switch between different regions impact the composition of academic work?, are there difference in the humandigital when comparing different

academic practices? From such an angle, it may also be possible to rethink the often perceived tensions between how academic work is being experienced on the one hand and more classical a priori conceptualizations of the nature of academic work on the other. Although classical distinctions between research, teaching, and service 'functions' or 'activity domains' are often used, it is unclear whether they are actually useful as account of what takes place in academic practice. Perhaps when all of these so-called different activities rely on similar academic boundary actors, humandigital interfaces, and the like, other accounts have to be given, and perhaps perceived tensions in academic practice can be made visual and textual.

In sum, sociomaterial approaches, focusing primarily on interactions, might constitute a fruitful addition to more traditional research about the university that is inclined to focus on epochal changes that are suggested or expected to alter the position of academics and the university (e.g. Fanghanel, 2011; Nelson & Wei, 2012; Weller, 2011). Whereas these more traditional approaches tend to conceive of the university and its inhabiting academics as consisting of firm structures and of fulfilling clearly delineated tasks, analyses like the one above might be beneficial in adopting an empirical gaze that focuses on practices and how these practices (and actors and relations as components of these practices) mediate the composition of academic work. Furthermore, this study can be considered as being complementary with studies that try to grasp the uniqueness of the university, either in terms of the specific functions that this organization performs or in terms of it instituting a unique idea (e.g. Barnett, 2011; Readings, 1996; Oakeshott, 2004). If we do not consider the university as a contrivance with a specific sets of functions or incorporating a specific idea, but rather approach the university in terms of practices that consist of various kinds of humandigital activities, the questions that are in need of further elaboration are: Which *forms* are typical of academic or university practices as they are enacted today?, and Are there *modes of being and interaction* that are typical of different academic practices? (see also, Masschelein & Simons, 2010). This is not only a sociological question on educational issues, but also an educational question in and on itself, and hence a first step in the development of an *educational* understanding and theory of academic practice drawing on relational and sociomaterial analyses.

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ⁱ Excellent introductions can be found in Latour (2005) and Fenwick and Edwards (2010).

ⁱⁱ This callousness towards the ontological status of actors in favor of a single-minded focus on heterogeneity of different actors possessing agency has been designated as *generalized symmetry*: each part of the traditional fissure between humans and non-humans is being given equal analytical consideration (Callon, 1986; Fenwick & Edwards, 2010; Law, 2009; Murdoch, 1997).

ⁱⁱⁱ This relational view is made intelligible maybe most clearly by pointing to the full reversibility of the statement that networks consist of actors. Indeed, according to ANT, an actor is also, always, a network itself – hence the simultaneous usage of the terms and the hyphen in *actor-network*. Each network is fully defined by its actors and the relations that are formed, but this also applies the other way around: each actor is fully defined by the network in which that actor resides (Latour et al., 2012; Law, 1992).

^{iv} In this study, the focus was on what might be called the *direct context of interaction*, i.e.: the actors designated by Mary as actors she interacted with directly. For instance, if the interviewee mentioned that she used a laptop, but not that she used this laptop whilst it was being charged, the charging cable was not mentioned as an actor, since this cable did not belong to the direct context of interaction. This hence concretely implies that the actor-network only mentions these actors that Mary herself stated as having interacted with directly. This decision to “cut” the network at the borders of the direct context of interaction might then be considered as a rather abrupt stopping of the process of assembling actors and interactions. However this might be true, the decision to cut the network someplace is an inevitable decision which always brings along some sort of premature closure: one can always extend the network further (Strathern, 1996).

^v A notion that we adopted from Bowker and Star's (1999) *boundary objects*.

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